

# ***Immersion Metrology for CMP Pad Monitoring***

Control Selectivity.

Reduce Rework.

Reduce Downtime.

Extend Pad Life.

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## Problem Statement:

Selectivity between materials being polished over the lifetime of the CMP consumable set will typically change. Changes in selectivity overtime are varied and complex, but one main contributor identified in this study using Sensofar immersion metrology, is the changing state of the polishing pad asperities overtime, (*aka Glazing*).

This study (of a damascene process) demonstrated;

- Successful monitoring of the same “wet” polishing pad while on the platen.
- Identification of multiple points in usage when glazing occurred
- Characterization of successful interventions to reverse the glazing effect
- Successful return to target selectivity
- Longer consumable lifetime
- Reduced manufacturing downtime (MTTR).

## What is S mart?



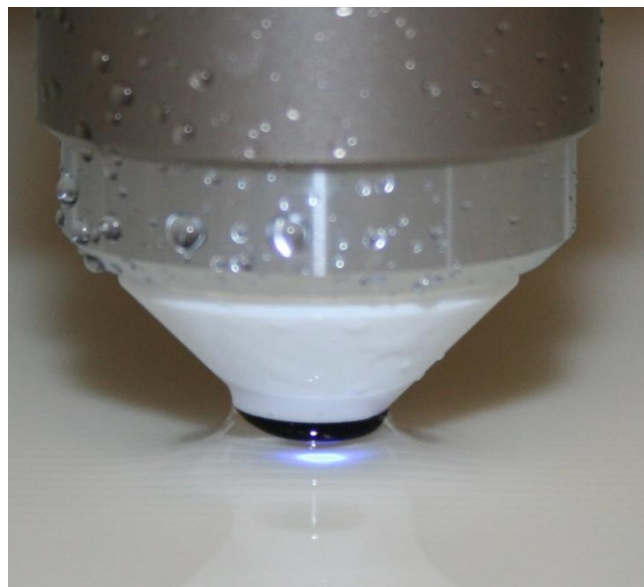
Co-Development between TDK & Sensofar in 2011. Facilitates the measurement of wet polishing pads while they remain on the tool, enabling potential **Cost** and **Quality** improvements through....

- *Allowing Pads to run out to their absolute limits by...*
  - *Controlling glazing through intervention.*
  - *Establishing minimum groove depth limits.*

**ONLY CHANGE THE PAD WHEN YOU ABSOLUTELY HAVE TO.**

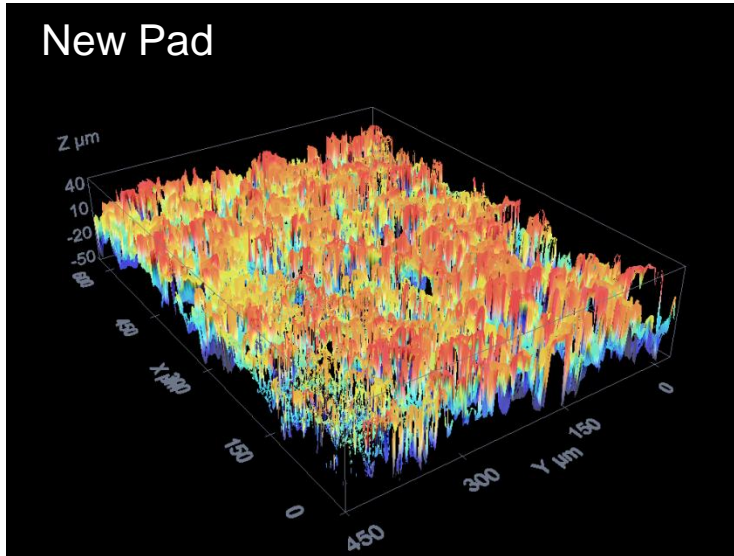
### *Other Potential Benefits....*

- *Faster troubleshooting of process excursions.*
  - *Quickly rule out the pad rather than just change it.*
- *Confirm pad state between process switches and/or prior to running high value wafers.*
- *During development dial in Pad/Disk Combination for a more robust process.*
- *Eliminate the need for Monitor wafer qualifications.*

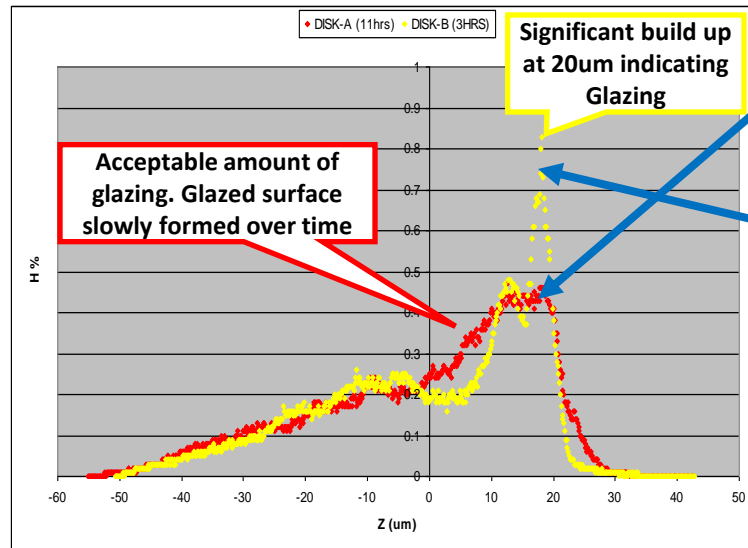
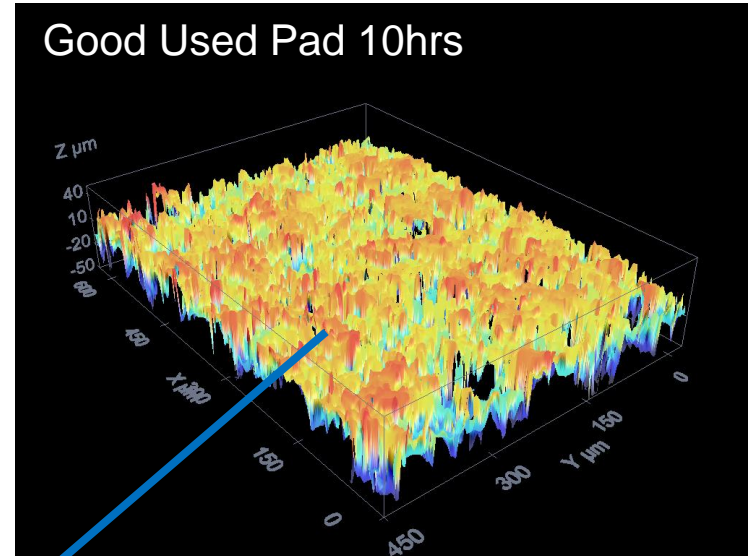


## What we Measure..... Asperities

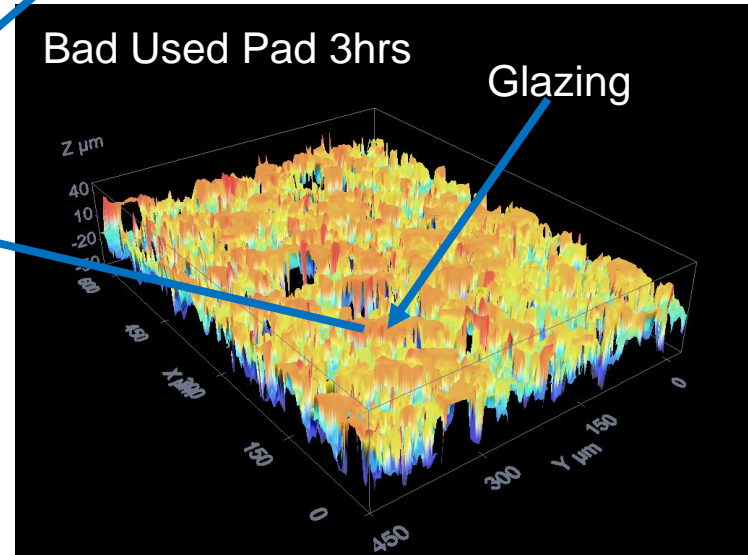
New Pad



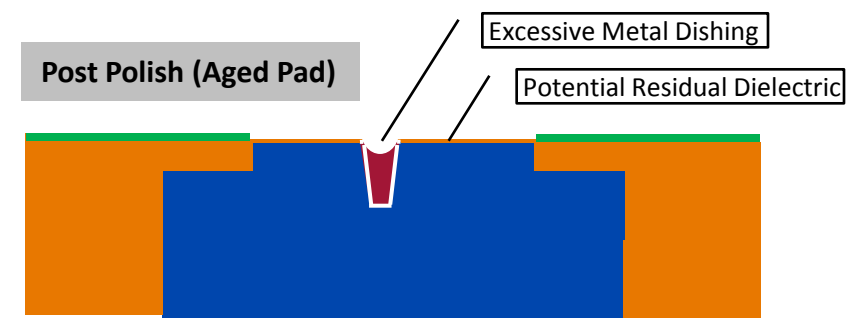
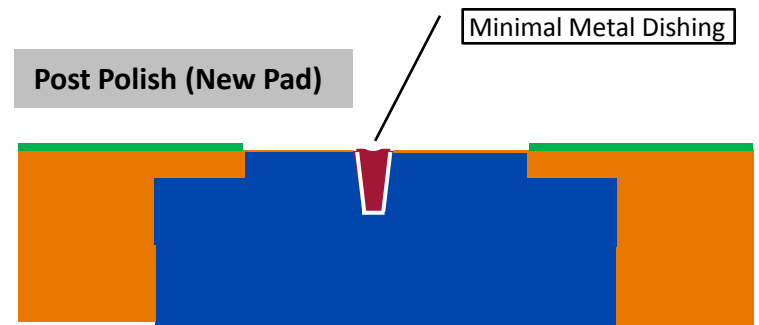
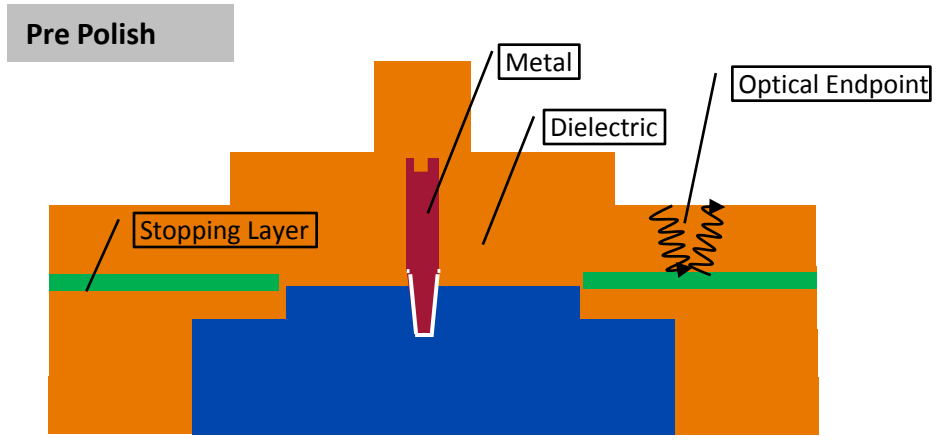
Good Used Pad 10hrs



Bad Used Pad 3hrs

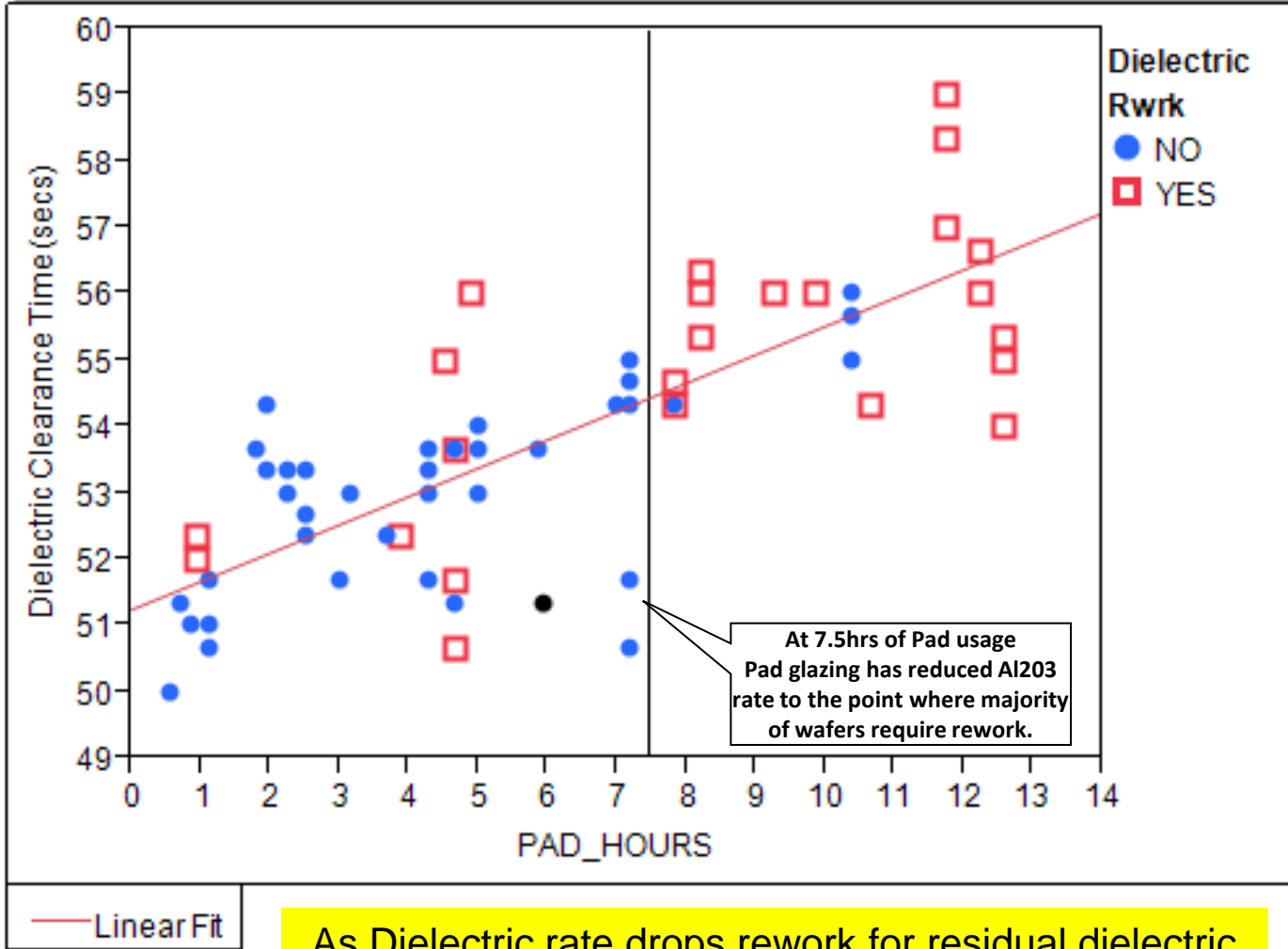


## Damascene Process



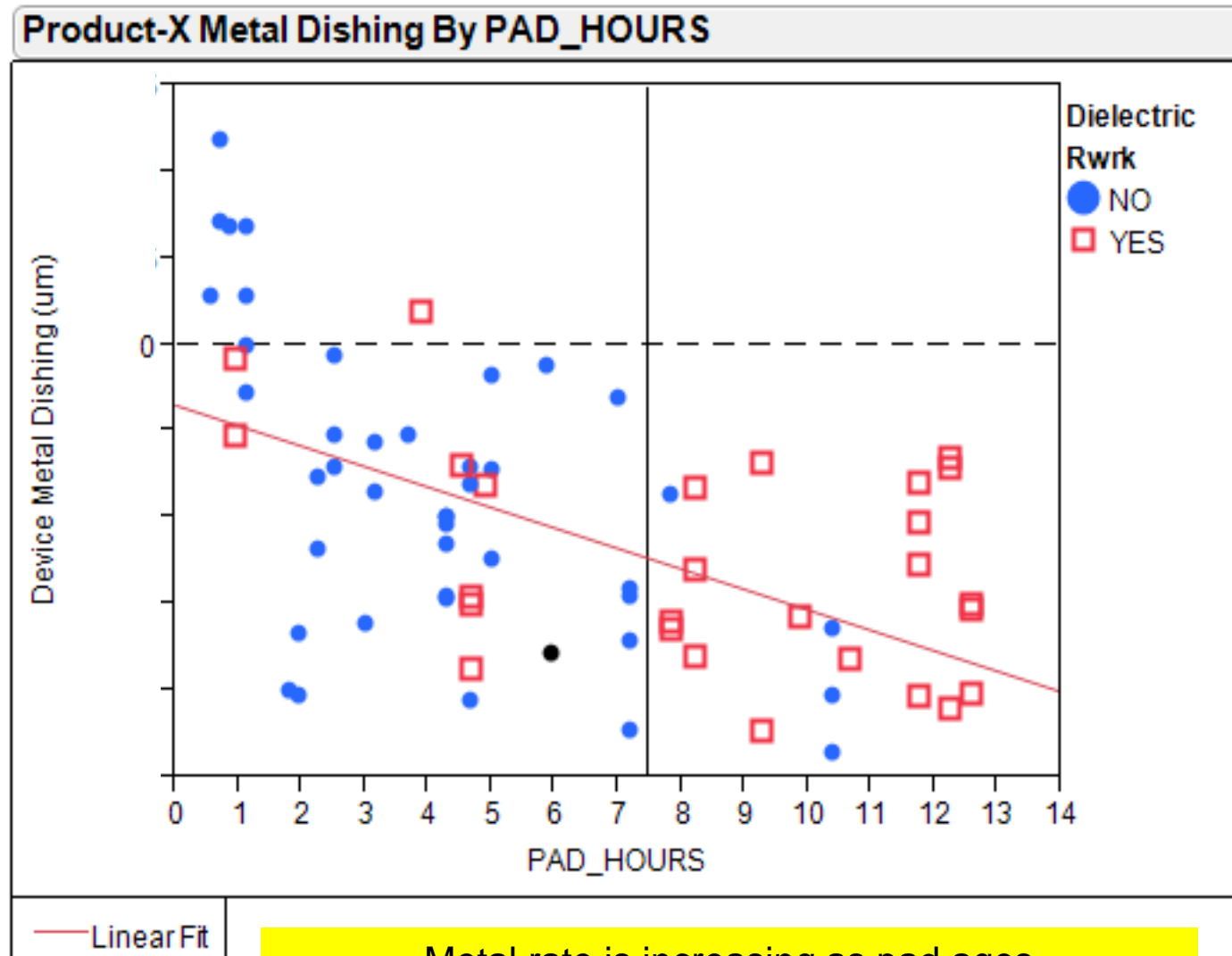
## PRODUCT-X Dielectric Selectivity Across 4 Separate pads

Product-X Dielectric Clearance By PAD\_HOURS



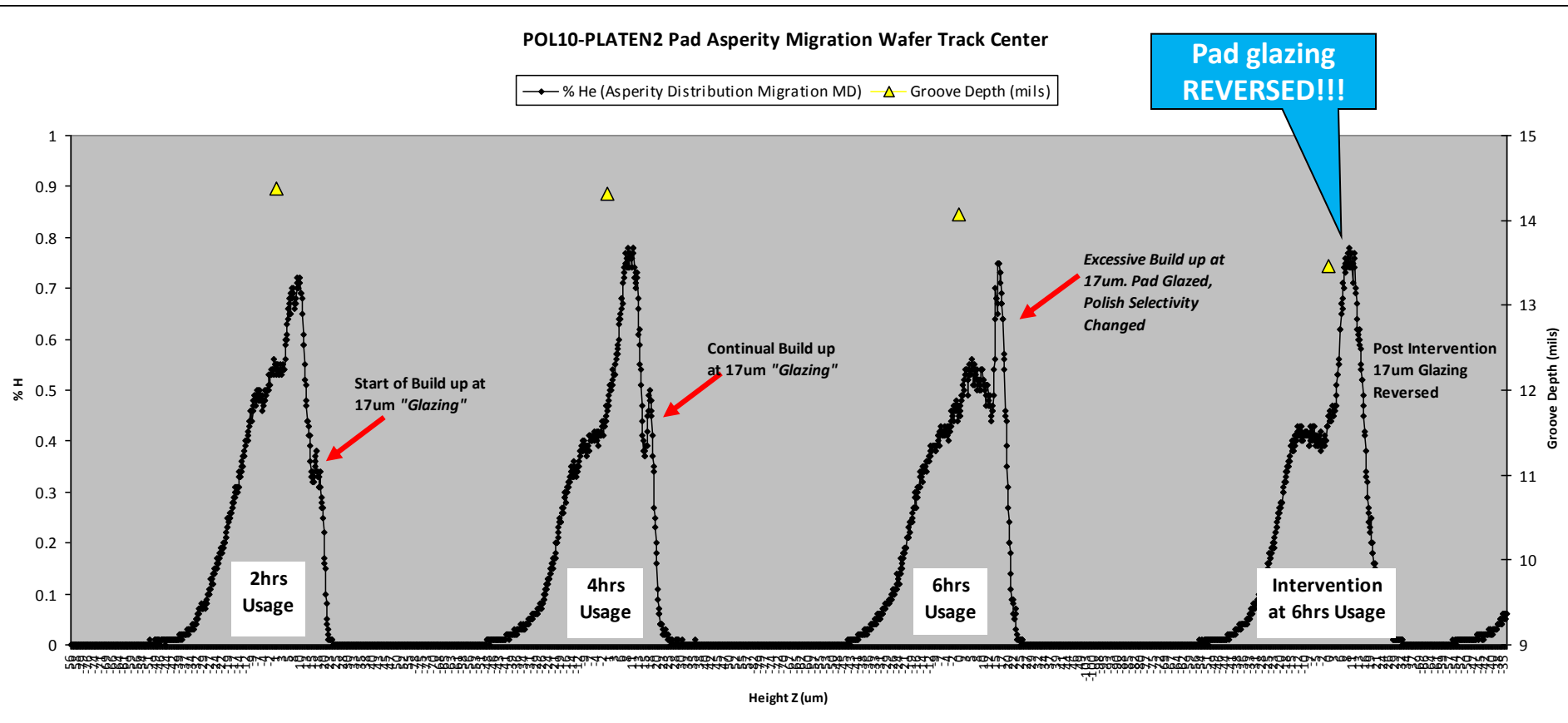
As Dielectric rate drops rework for residual dielectric increases.

## PRODUCT-X Metal Selectivity Across 4 Separate pads



Metal rate is increasing as pad ages

## Measurement Results 2-6Hrs

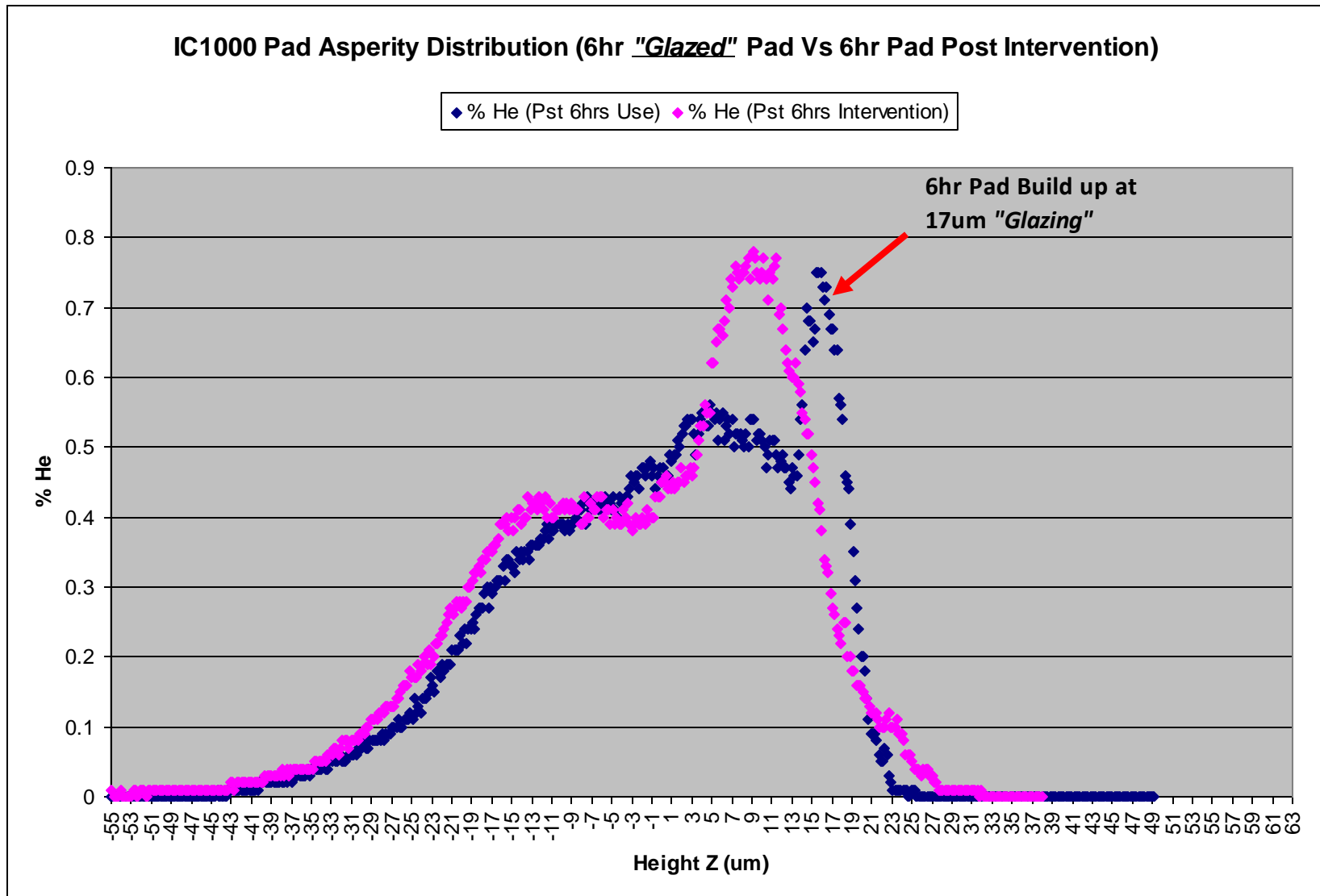


With S mart we were able to.....

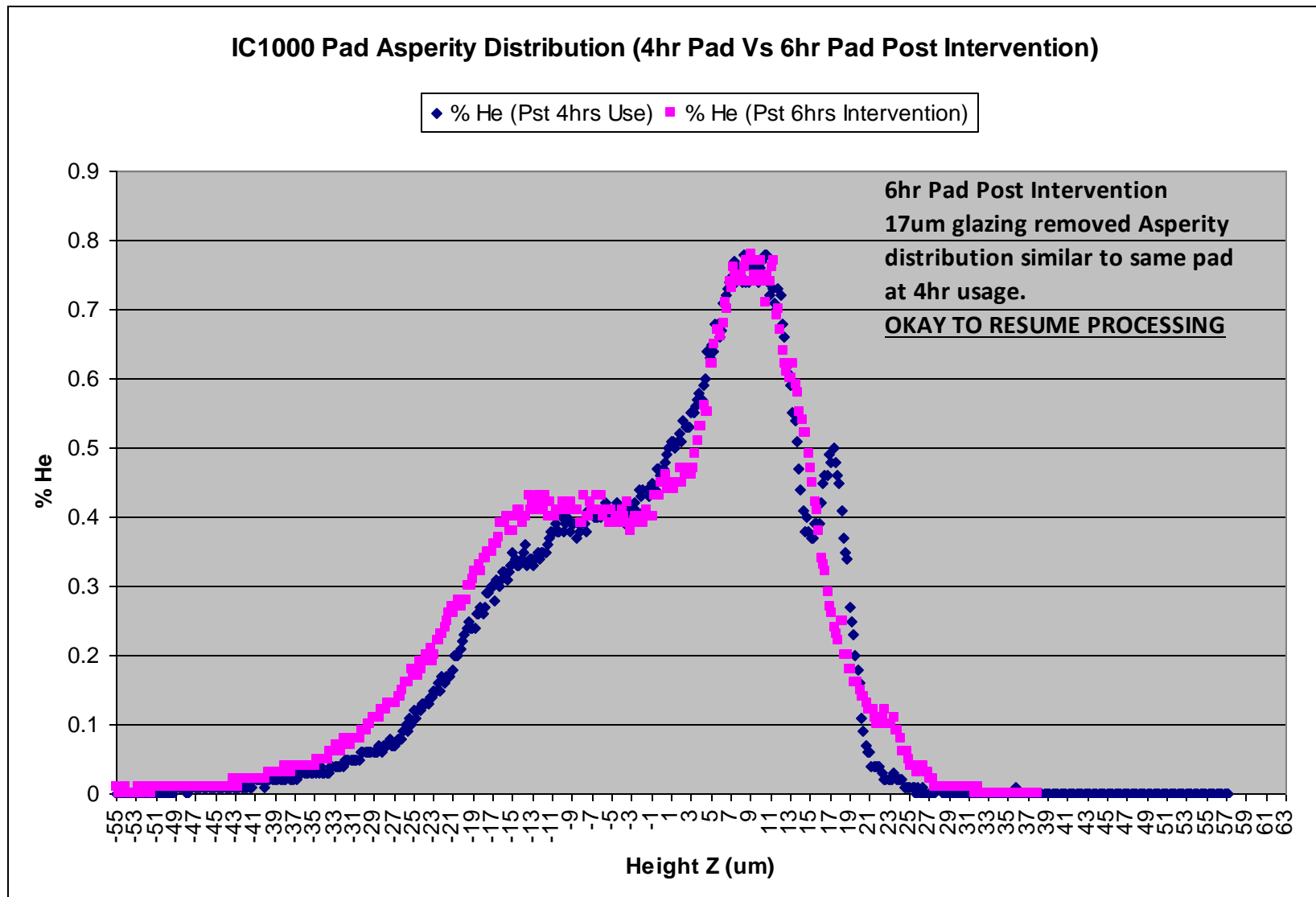
- Monitor the pad Asperity height and Groove Depth.
- Identify the point at which the pad glazed where Dielectric/Metal selectivity mismatch is problematic.
- Dial in an Intervention scheme that reversed the pad glazing & allowed MFG to resume processing.



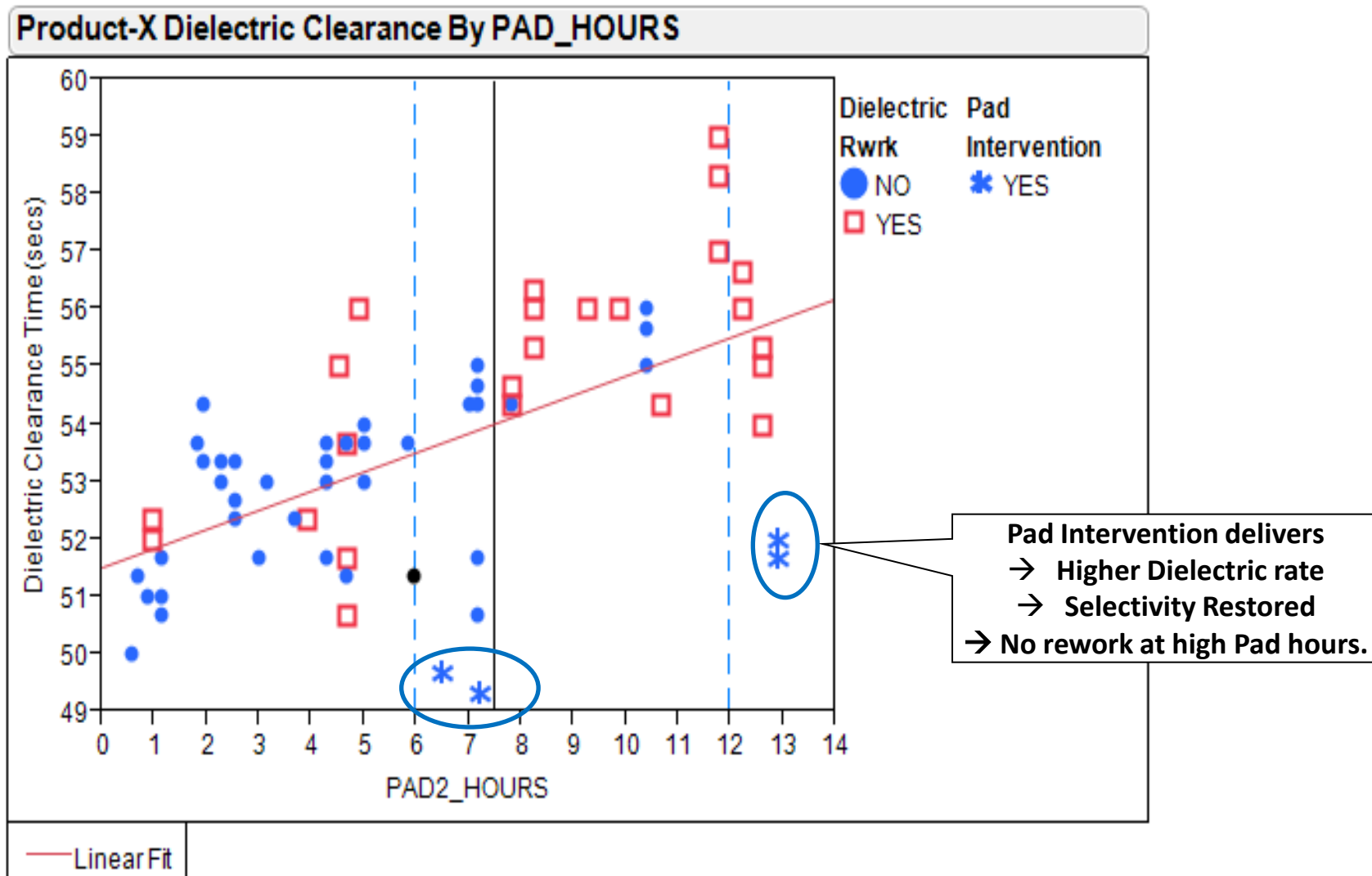
Measurement Result: Post Intervention distribution compared to “Glazed” Pad.



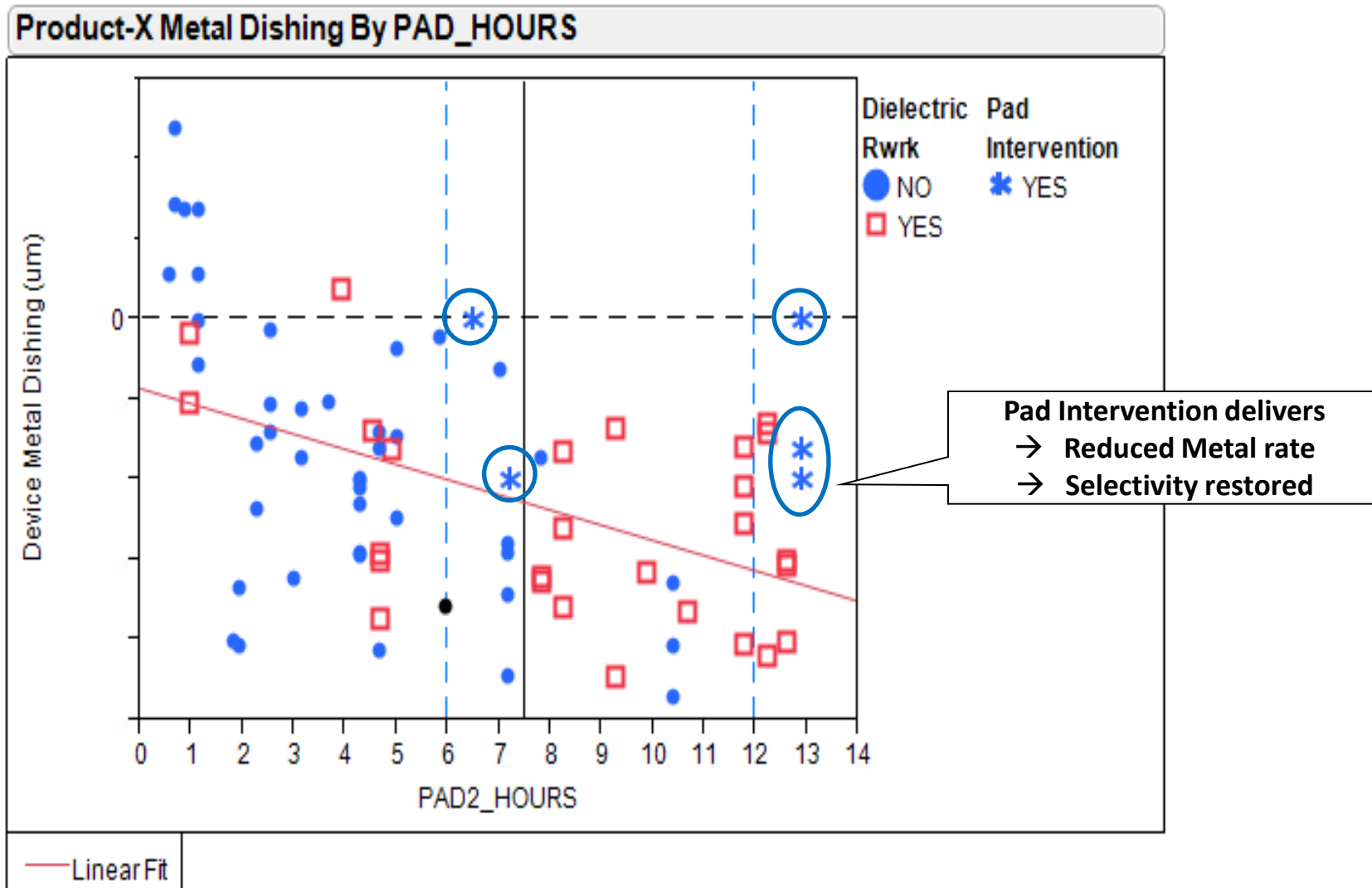
6hr Intervention Result: Overlaying with 4hr Pad State shows good match with desired Asperity Height Distribution Profile. Okay to Proceed w/MFG wfs.



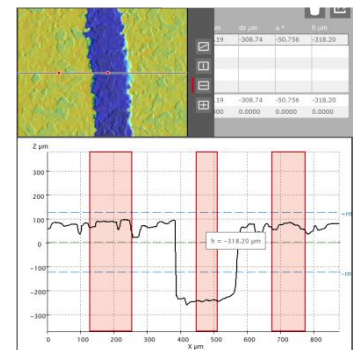
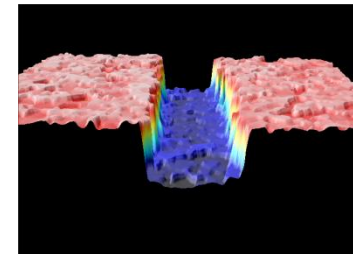
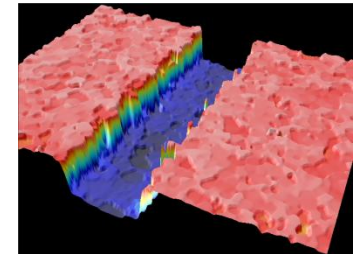
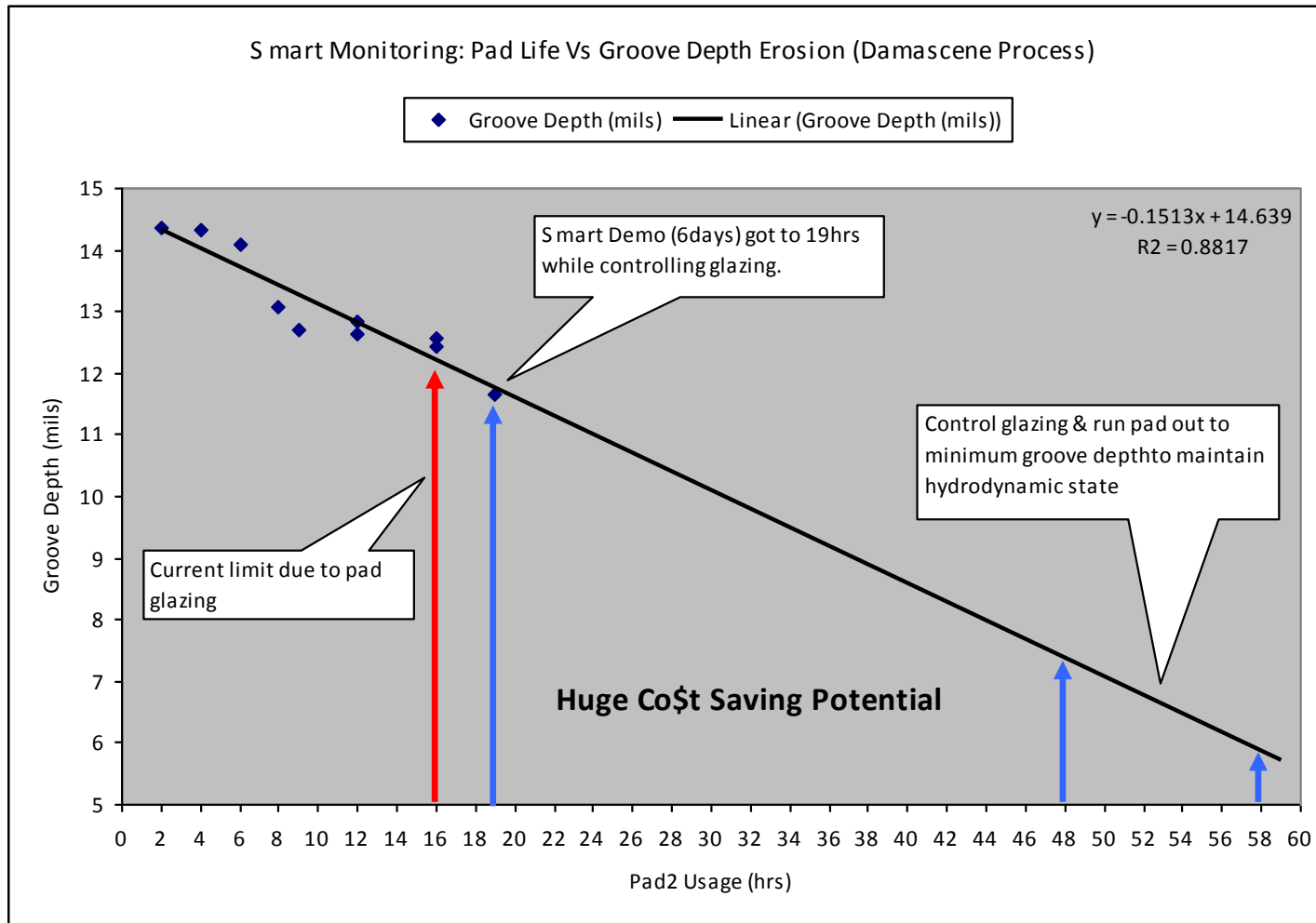
Intervention Result: How do we know that intervention worked?



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## Summary: Groove Depth



**We were throwing pads away prematurely due to glazing.  
Monitor/Control Glazing = Extended Pad life**

## Hardware Overview

